4. PRODUCTION, IMPORT, USE, AND DISPOSAL

4.1 PRODUCTION

Production of vinyl chloride monomer in the United States was approximately 14.98 billion pounds (6.80 billion kilograms) in 1995 (C&EN 1996), an increase of 8% over 1994 production. This exceeds the latest available U.S. estimated total production capacity figure (beginning of 1993) of 12.79 billion pounds (5.81 billion kilograms) at the beginning of 1993 (SRI 1993) and represents a substantial recent increase in production and capacity. Previously, vinyl chloride production had grown only l-5% per year over the last 5 years (C&EN 1994). Over the last 10 years, vinyl chloride production has grown at an average rate of about 7%, not including the large increase of 22% in 1993, although production volumes were fairly volatile (C&EN 1994).

Vinyl chloride is currently produced in the United States by 10 companies at 12 facilities, which are as follows: Westlake Monomers Corporation in Calvert City, Kentucky; Borden Chemicals and Plastics in Geismar, Louisiana; Dow Chemical in Oyster Creek, Texas, and in Plaquemine, Louisiana; Georgia Gulf Corporation in Plaquemine, Louisiana; PPG Industries in Lake Charles, Louisiana; Vista Chemical Company in Lake Charles, Louisiana; The Geon Company in LaPorte, Texas; Formosa Plastics Corporation in Baton Rouge, Louisiana, and in Point Comfort, Texas; Occidental Chemical Corporation in Deer Park, Texas; and Oxymar in Ingleside, Texas (SRI 1995). Table 4-l summarizes the facilities in the United States that manufacture or process vinyl chloride. This information was obtained from the Toxic Chemical Release Inventory (TRI), and it summarizes the reported release data for 1993 (TRI93 1995). Table 4-l also lists the maximum amounts of vinyl chloride that are present at these sites and the end uses of the vinyl chloride.

Vinyl chloride was first produced commercially in the 1930s by reacting hydrogen chloride with acetylene. Currently, vinyl chloride is produced commercially by the chlorination of ethylene through one of two processes, direct chlorination or oxychlorination. Direct chlorination reacts ethylene with chlorine to produce 1,2-dichloroethane. Similarly, oxychlorination produces 1,2-dichloroethane, but this is accomplished by reacting ethylene with dry hydrogen chloride and oxygen. After both processes, the 1,2-dichloroethane is subjected to high pressures (2.5-3.0 megapascals) and temperatures

Table 4-1. Facilities That Manufacture or Process Vinyl Chloride

Facility	Location[a]	Range of maximum amounts on site in pounds	Activities and uses
UNION CARBIDE CORP.	TORRANCE, CA	10,000-99,999	As a reactant
NA	SAUGUS, CA	1,000,000-9,999,999	As a reactant
GEORGIA GULF CORP.	DELAWARE CITY, DE	1,000,000-9,999,999	As a reactant
FORMOSA PLASTICS CORP. USA	DELAWARE CITY, DE	1,000,000-9,999,999	As a reactant
WESTLAKE VINYLS CORP.	PACE, FL	1,000,000-9,999,999	As a reactant
GEON CO.	HENRY, IL	1,000,000-9,999,999	As a reactant
BORDEN INC.	ILLIOPOLIS, IL	No Data	As a reactant
BF GOODRICH CO.	LOUISVILLE, KY	10,000-99,999	As a reactant
GEON CO.	LOUISVILLE, KY	1,000,000-9,999,999	As a reactant
NA	CALVERT CITY, KY	10,000-99,999	As a reactant
WESTLAKE GROUP	CALVERT CITY, KY	1,000,000-9,999,999	As a reactant
WESTLAKE CHEMICAL CORP.	CALVERT CITY, KY	1,000,000-9,999,999	Produce; For sale/distribution
NA	GEISMAR, LA	100,000-999,999	Produce; For on-site use/processing; As a by-product; As a reactant
NA	GEISMAR, LA	No Data	Produce; For on-site use/processing; For sale/distribution; As a reactant
NA	SULPHUR, LA	1,000,000-9,999,999	As a reactant
NA	WESTLAKE, LA	No Data	Produce; For sale/distribution
PPG IND. INC.	LAKE CHARLES, LA	No Data	Produce; For sale/distribution; As a by-product; As an impurity; As a reactant
FORMOSA PLASTICS CORP. USA	BATON ROUGE, LA	1,000,000-9,999,999	Produce; For on-site use/processing; For sale/distribution; As a by-product; As a reactant
RHONE-POULENC INC.	BATON ROUGE, LA	100,000-999,999	Ancillary uses
NA	PLAQUEMINE, LA	No Data	Produce; For on-site use/processing; For sale/distribution; As a reactant
DOW CHEMICAL CO.	PLAQUEMINE, LA	No Data	Produce; For sale/distribution; As a reactant; As a manufacturing aid; Ancillary uses
OCCIDENTAL PETROLEUM CORP.	ADDIS, LA	100,000-999,999	As a reactant
DOW CHEMICAL CO.	MIDLAND, MI	100,000-999,999	As a reactant; Ancillary uses
MILES INC.	KANSAS CITY, MO	100,000-999,999	As a reactant

Table 4-1. Facilities That Manufacture or Process Vinyl Chloride (continued)

Facility	Location[a]	Range of maximum amounts on site in pounds	Activities and uses
NA	ABERDEEN, MS	No Data	As a reactant
OCCIDENTAL PETROLEUM CORP.	BURLINGTON, NJ	1,000,000-9,999,999	As a reactant
GEON CO.	PEDRICKTOWN, NJ	1,000,000-9,999,999	As a reactant
GOODYEAR TIRE & RUBBER CO.	NIAGARA FALLS, NY	100,000-999,999	As a reactant
GEON	AVON LAKE, OH	1,000,000-9,999,999	As a reactant
NA	OKLAHOMA CITY, OK	1,000,000-9,999,999	As a reactant
OCCIDENTAL PETROLEUM CORP.	POTTSTOWN, PA	1,000,000-9,999,999	As a reactant
SHIN ETSU	FREEPORT, TX	No Data	Import; For on-site use/processing; As a reactant
DOW CHEMICAL USA	FREEPORT, TX	No Data	Produce; As a by-product; As an impurity; As a reactant; Ancillary uses
FORMOSA PLASTICS CORP. USA	POINT COMFORT, TX	No Data	Produce; For on-site use/processing; As a by-product; As a reactant
UNION CARBIDE	GARLAND, TX	100,000-999,999	As a reactant
UNION CARBIDE CORP.	TEXAS CITY, TX	1,000,000-9,999,999	As a reactant
OCCIDENTAL PETROLEUM CORP.	LA PORTE, TX	1,000,000-9,999,999	Ancillary uses
OCCIDENTAL PETROLEUM CORP.	DEER PARK, TX	No Data	Produce; For sale/distribution
OCCIDENTAL PETROLEUM CORP.	PASADENA, TX	No Data	As a reactant
GEON CO.	LA PORTE, TX	No Data	Produce; For sale/distribution
GEON CO.	DEER PARK, TX	1,000,000-9,999,999	As a reactant
OCCIDENTAL PETROLEUM CORP.	GREGORY, TX	No Data	Produce; For sale/distribution
NA	PULASKI, VA	100,000-999,999	As a formulation component

Source: TRI93 1995

[a] Post office state abbreviations used

NA = not available

(550-550°C). This causes the 1,2-dichloroethane to undergo pyrolysis, or thermal cracking, which forms the vinyl chloride monomer and hydrogen chloride. The vinyl chloride monomer is then isolated (Cowfer and Magi&o 1985). The technical-grade product is available in 99.9% purity (HSDB 1996). Efforts are being made to minimize by-product formation in 1,Zdichloroethane pyrolysis (Cowfer and Magistro 1985).

4.2 IMPORT/EXPORT

Imports of vinyl chloride totaled 29 million pounds (13.17 million kilograms) in 1994 and 164 million pounds in 1991 (CPS 1993; NTD 1995). Imports have been steadily declining from a high of 302 million pounds in 1989, prior to which they had been increasing (CPS 1993). Exports of vinyl chloride were 1.65 billion pounds (0.75 billion kilograms) in 1992 and 2.10 billion pounds (0.95 billion kilograms) in 1994 (NTD 1995). Over the past 20 years, exports of vinyl chloride have fluctuated fairly widely but increased a total of about 58% from 1990 to 1994 (NTD 1995).

4.3 USE

Vinyl chloride is an important industrial chemical because of its wide variety of end-use products and the low cost of producing polymers from it. Furthermore, PVC is one of the most efficient construction materials available when analyzed on an energy-equivalent basis (Cowfer and Magistro 1985). Major end-use products include PVC products, such as automotive parts and accessories, furniture, packaging materials, pipes, wall coverings, and wire coatings, as well as vinyl chloride-vinyl acetate copolymer products, such as films and resins (Cowfer and Magistro 1985; Eveleth et al. 1990). Enduse data for 1992 indicate that 98% of vinyl chloride monomer production is for making PVC and various PVC copolymers; the other 2% is for miscellaneous uses (CPS 1993).

Vinyl chloride has been used in the past as a refrigerant, as an extraction solvent for heat-sensitive materials, and in the production of chloroacetaldehyde and methyl chloroform (IARC 1979). In the United States, limited quantities of vinyl chloride were used as an aerosol propellant and as an ingredient of drug and cosmetic products; however, these practices were banned by the EPA in 1974 (HSDB 1996; IARC 1979).

4.4 DISPOSAL

Since vinyl chloride has been identified by EPA as a hazardous material, its disposal is regulated under the Federal Resource Conservation and Recovery Act (RCRA) (EPA 1993d). The transportation of hazardous materials for disposal is regulated by the Department of Transportation in compliance with this act (DOT 1993). The recommended method of disposal is total destruction by incineration. The temperature of the incinerator must be sufficient to ensure the complete combustion of the vinyl chloride in order to prevent the formation of phosgene. The recommended temperature range for incineration is 450-1,600°C, with residence times of seconds for gases and liquids, and hours for solids (HSDB 1996). If in solution, the vinyl chloride product may need to be adsorbed onto a combustible material prior to incineration. Recommended materials include vermiculite, sawdust, or a sand-soda ash mixture (90/10) covered with wood and paper (OHM/TADS 1985). The vinyl chloride can also be dissolved in a flammable solvent prior to incineration. An acid scrubber should be used in conjunction with the incinerator in order to remove any hydrogen chloride that is produced by the combustion process (HSDB 1996; OHM/TADS 1985). Alternatively, chemical destruction may be used, especially with small quantities. From 1 to 2 days is generally sufficient for complete destruction (HSDB 1996).

Aqueous by-product solutions from the production of vinyl chloride are usually steam-stripped to remove volatile organic compounds, neutralized, and then treated in an activated sludge system to remove nonvolatile organic compounds remaining in the waste water (Cowfer and Magistro 1983).